climate change initiative

→ FIRE

“Recent progress of the FireCCI project”

Emilio Chuvieco, Universidad de Alcalá

On behalf the FireCCI consortium

fire cci

ESA CCI

GITA
UNIVERSIDAD DE ALCALÁ

Land

- biomass cci
- fire cci
- high resolution land cover cci
- lakes cci
- land cover cci
- land surface temperature cci

Atmosphere

- aerosol cci
- cloud cci
- ghg cci
- ozone cci
- water vapour cci

Ocean

- salinity cci
- sst cci
- sea state cci
- sea ice cci
- sea level budget closure cci
- sea level cci
- ocean colour cci

Ice

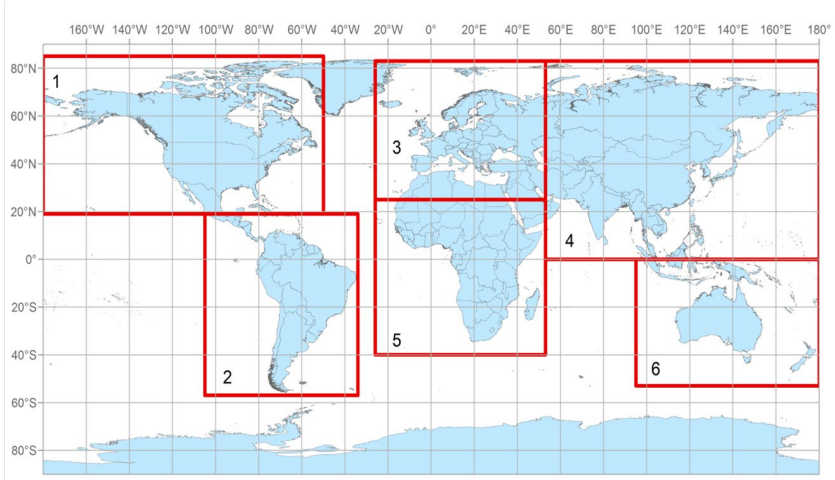
- antarctic ice sheet cci
- glaciers cci
- greenland ice sheet cci
- permafrost cci
- snow cci

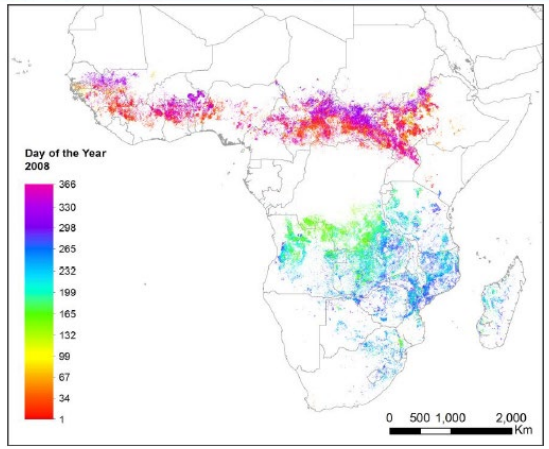
Transversal

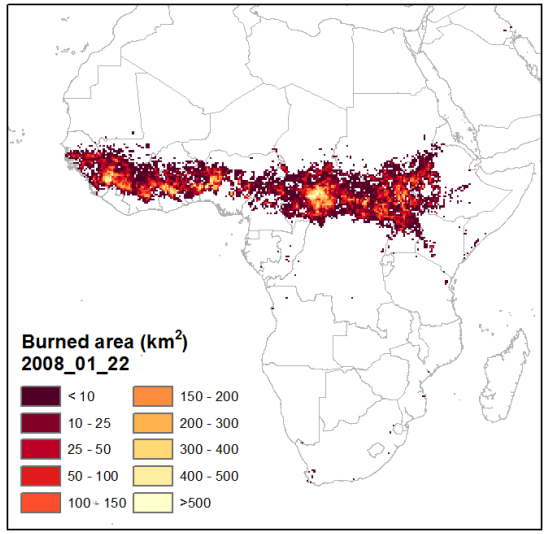
- cmug cci
- open data portal cci
- toolbox cci

BA product specifications

- Pixel product:
  - Monthly files, continental tiles, GeoTiff format.
  - 3 Variables: Day of detection (1-366), Confidence level (0-100), Burned land cover (derived from LC_cci).







- Grid product:
  - Monthly global files at 0.25 x 0.25 degree. NetCDF format.
  - 23 variables: total burned area, standard error, fraction of burnable area, fraction of observed area, and burned area of each land cover.

FireCCI BA algorithms

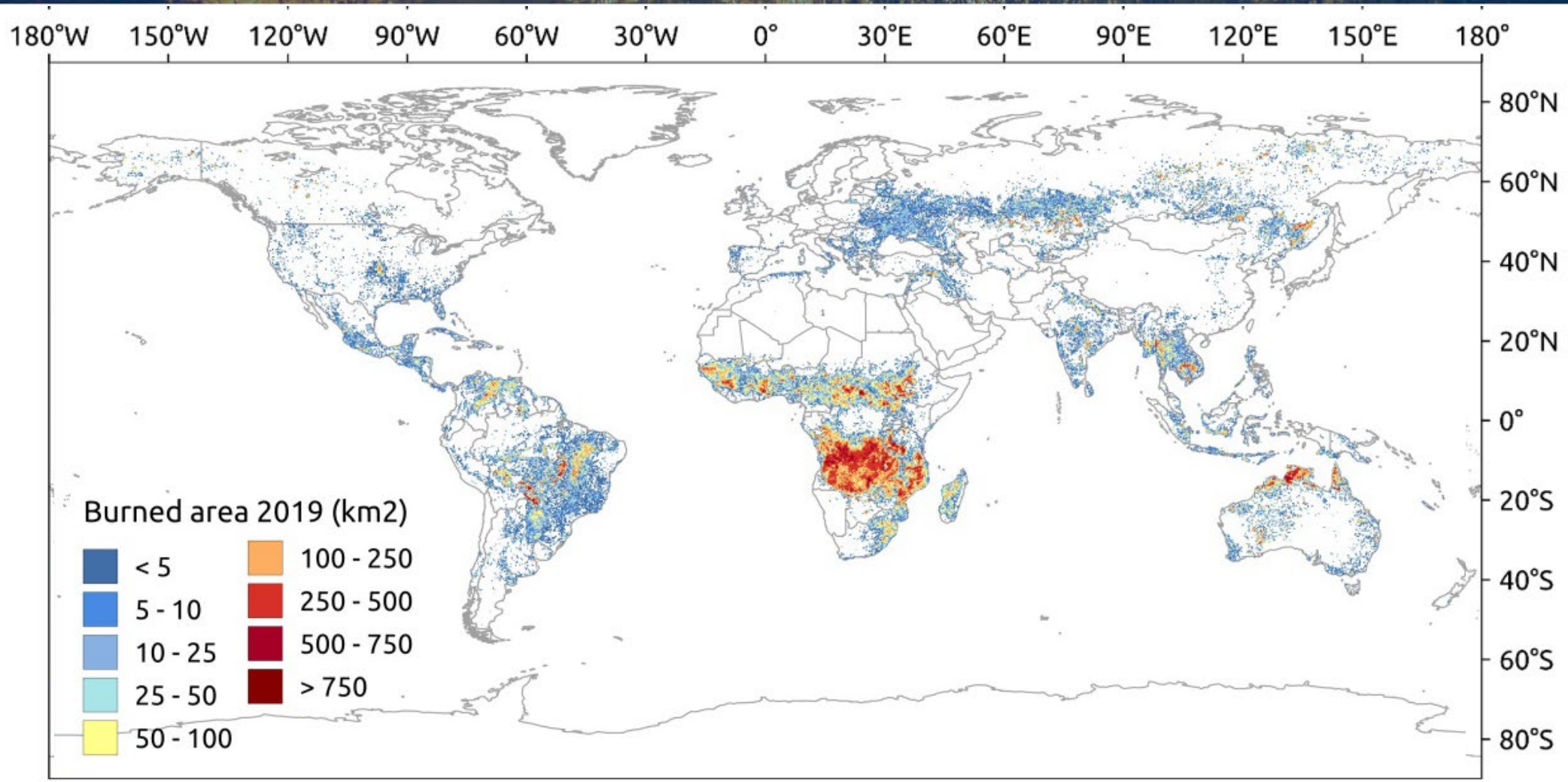
Adapted to the different input sensors:

- MERIS, 300 m.
- MODIS, 250m.
- Sentinel-3, OLCI 300 m
- Sentinel-3, SYN 300 m.
- AVHRR – LTDR, 5 km.
- Sentinel-1 SAR, 40 m
- Sentinel-2 MSI, 20 m.

Common approaches:

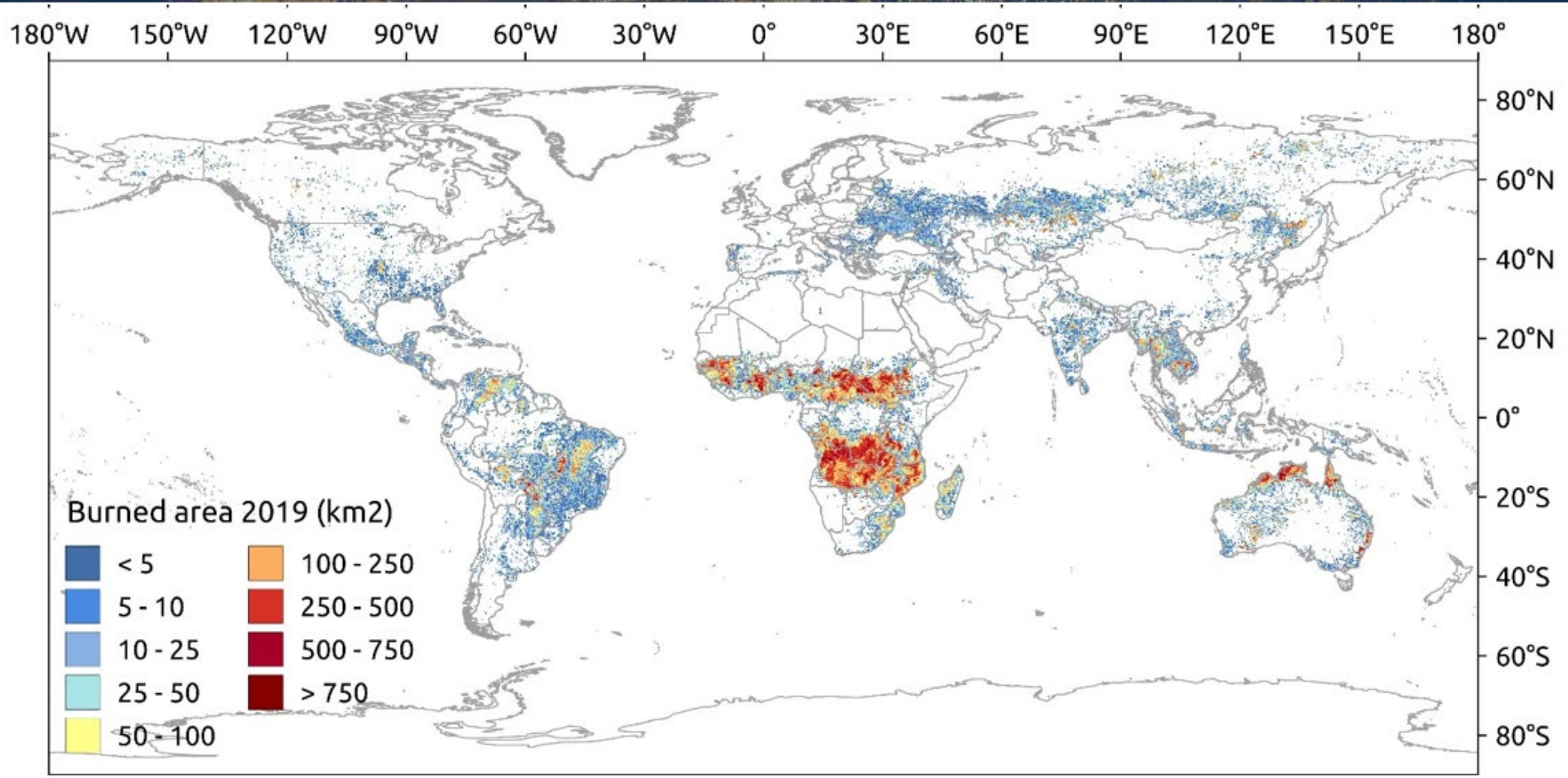
- Hybrid algorithms: active fires guide BA detection.
- Two-phase: seed + growing.
- Locally adapted.
- Based on temporal composites.

FireCCI51 (MODIS 250m + HS)



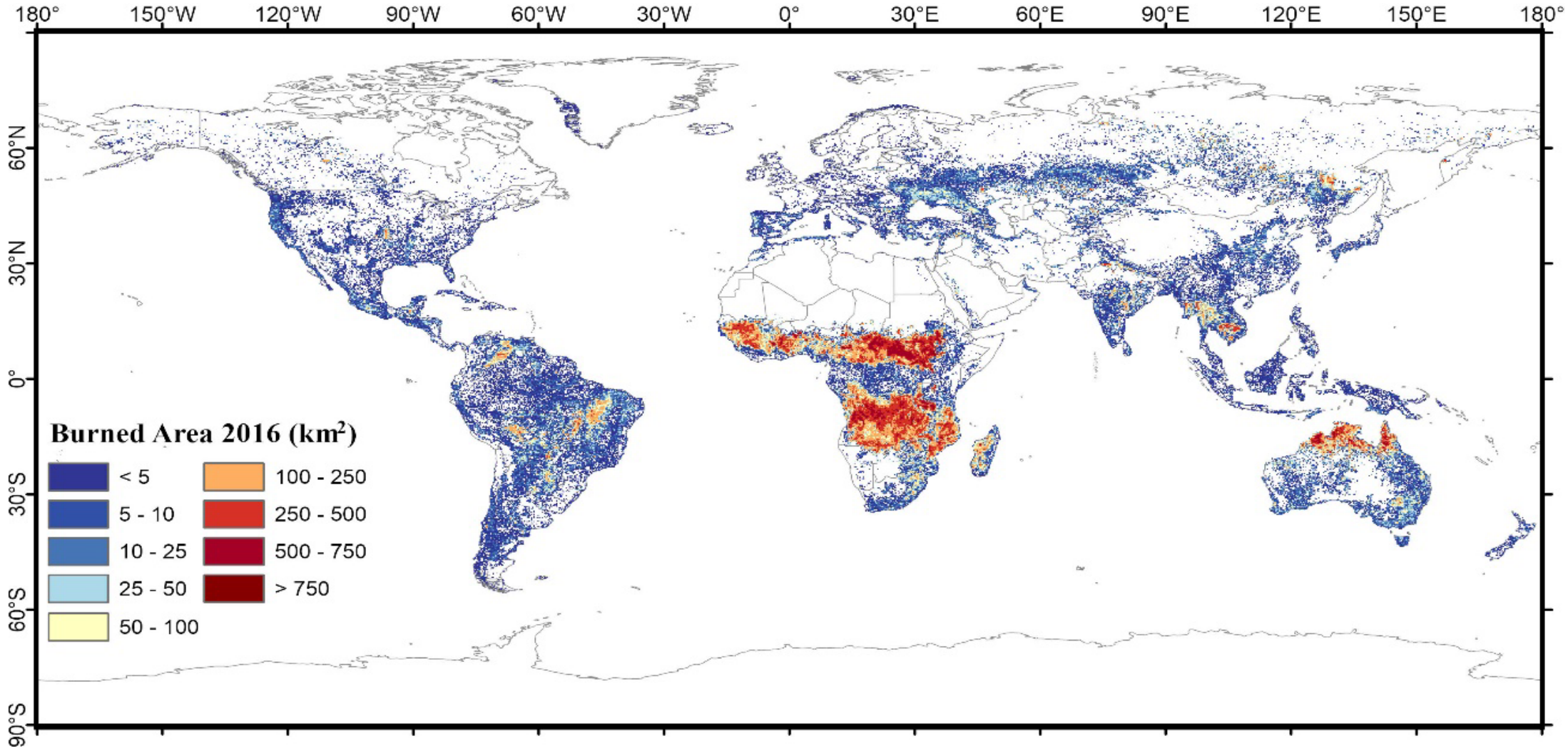
Lizundia-Loiola et al., 2020, RSE

C3SBA10 (OLCI 300m + HS)



Lizundia-Loiola et al., 2021, RS

FireCCILT11 (AVHRR 0.05 d)

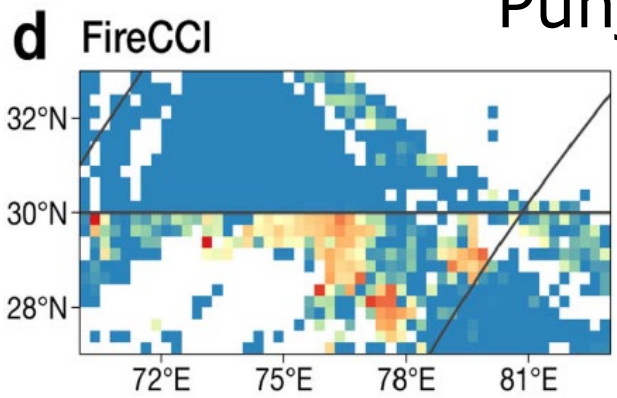


Oton et al., 2021, IJAG

Recent advances of global products

- Sentinel-3 SYN data 300 m + VIIRS AF.
- Border effects.
- Temporal reporting accuracy.
- High omission errors.

Punjab



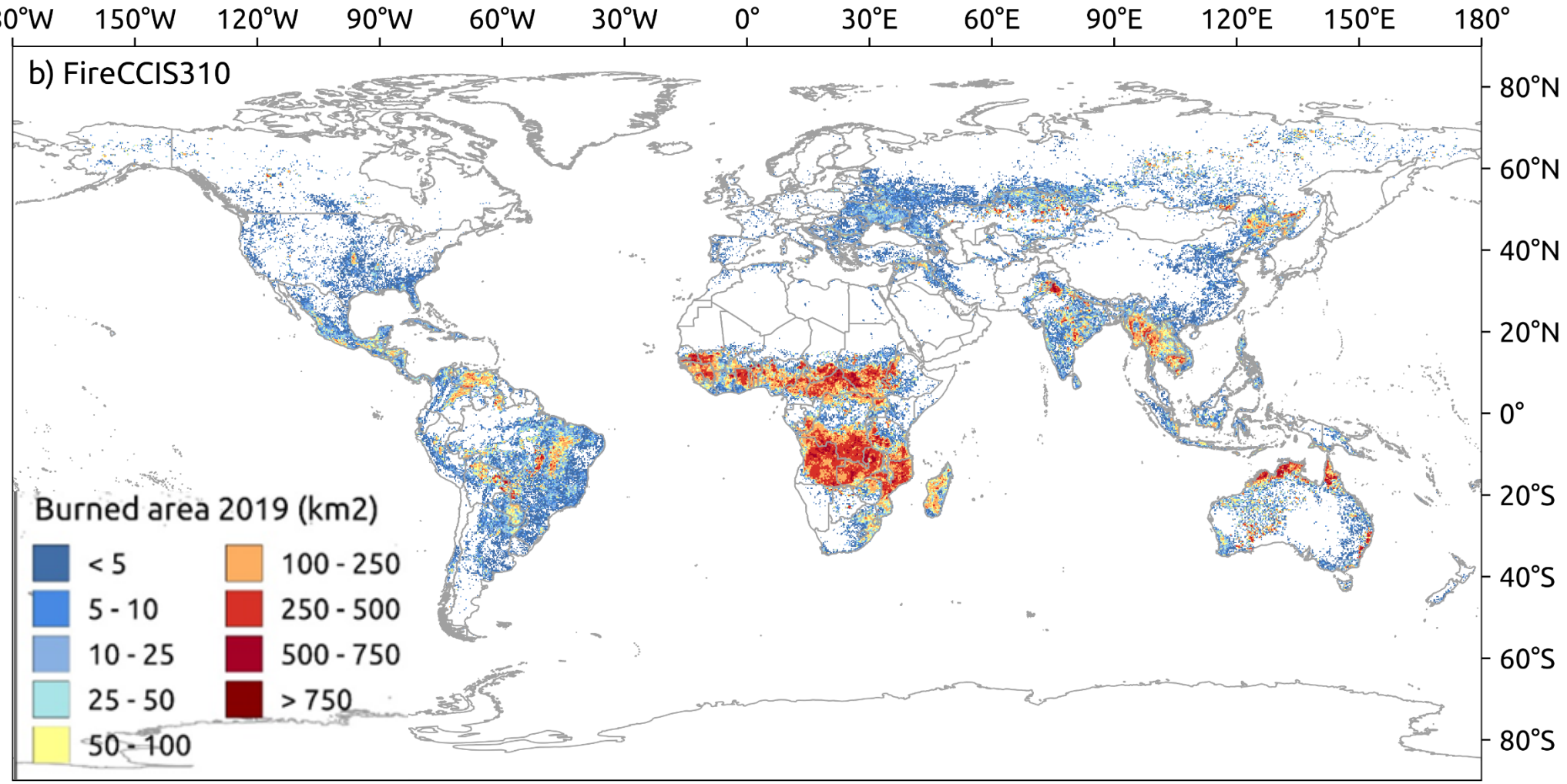
- Algorithm development and testing for 2019.
- NBR2, instead of NIR
- VIIRS, instead of MODIS AF
- LC C3S, instead of LC CCI.
- Flexible compositing, instead of 20 days
- Contextural instead of Tile-based+contextual.

Table 4
Global accuracy estimates [%] for the three products aggregated over the three validation years. The standard error is shown in parenthesis.

Period	2017–2019		
	C3SBA10	FireCCI51	MCD64C6
DC	62.9 (1.6)	66.7 (1.5)	62.5 (1.8)
Ce	17.2 (1.1)	19.4 (1.1)	18.7 (1.4)
Oe	49.3 (1.9)	43.1 (1.9)	49.3 (2.2)
relB	−38.7 (2.2)	−29.4 (2.1)	−37.6 (2.6)

Franquesa et al., (2022)

FIRECCIS310 (SYN 300m + VIIRS)

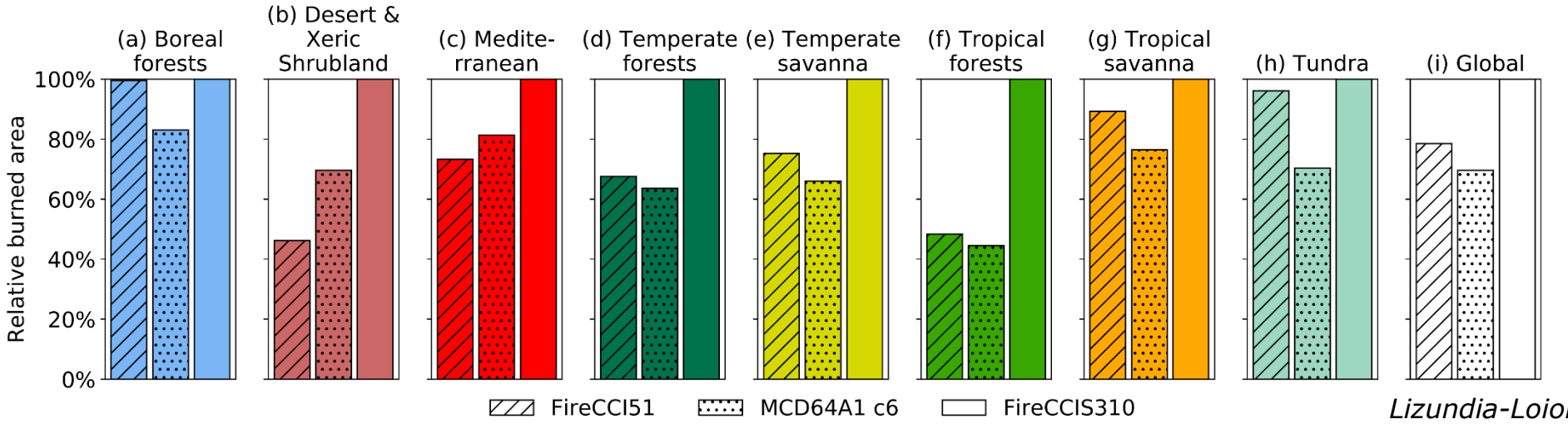


Lizundia-Loiola et al., 2022, RSE, In review

Results: global burned area

Table 4. Burned area (km^2) of the year 2019 for each product and biome.

	FireCCI51	MCD64A1 c6	FireCCIS310	
Boreal forest	86711	72370	87145	
Deserts & xeric shrublands	116907	176164	253192	**+116%**
Mediterranean	29162	32364	39765	
Temperate forest	111999	105320	165621	**+48%**
Temperate savanna	165610	145221	220141	
Tropical forest	433493	400165	897703	**+107%**
Tropical savanna	2958452	2529860	3311552	
Tundra	11531	8437	12000	
Global	3913865	3469901	4987119	**+27%**



Lizundia-Loiola et al., in review

Results: global spatial validation

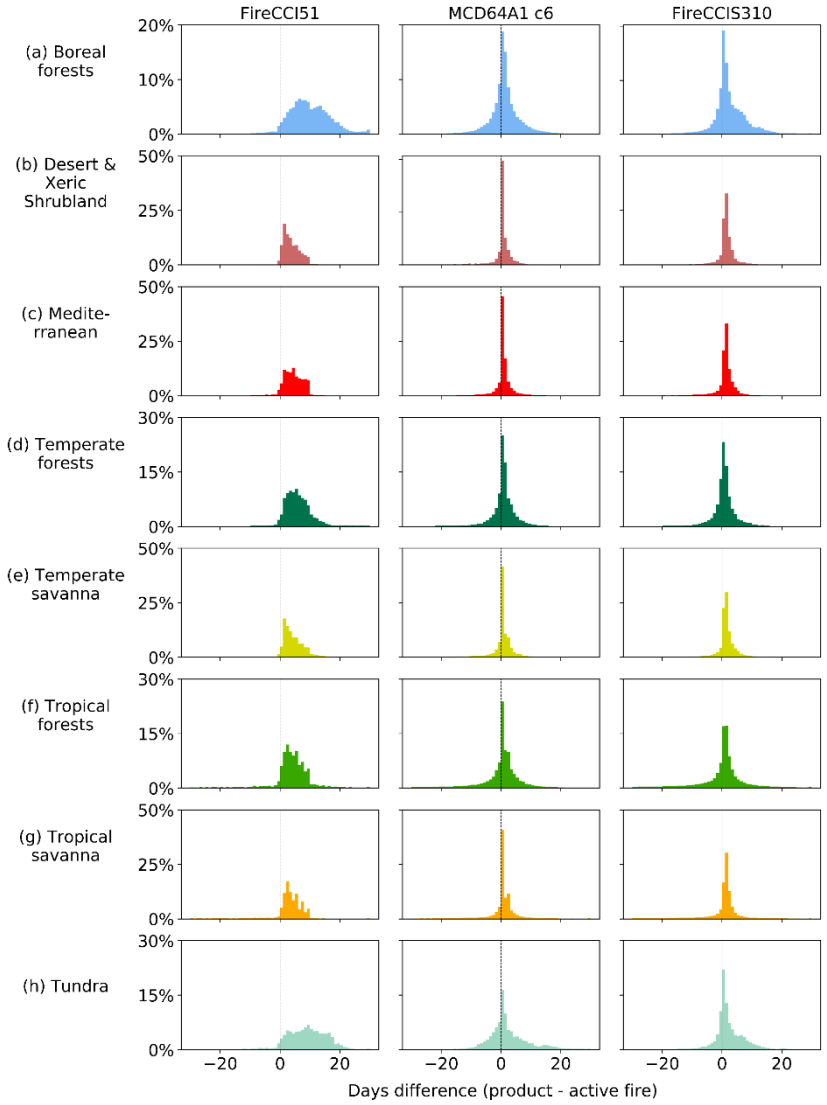
- Global validation for 2019 / 105 reference tiles

Table 1. Global error estimates [%] for the three products and year 2019, with the standard error in parenthesis. Data for FireCCI51, and MCD64A1 c6 was extracted from Table 5 of Franquesa et al. (2022). In bold the product that shows the highest accuracy in each specific metric.

	FireCCI51	MCD64A1 c6	FireCCIS310
DC	63.9 (2.8)	59.8 (3.2)	**68.1 (2.5)**
Ce	20.8 (1.7)	**17.5 (1.4)**	19.2 (1.7)
Oe	46.5 (3.4)	53.1 (3.6)	**41.2 (3.0)**
relB	-32.5 (3.4)	-43.1 (3.8)	**-27.2 (2.7)**

Lizundia-Loiola et al., in review

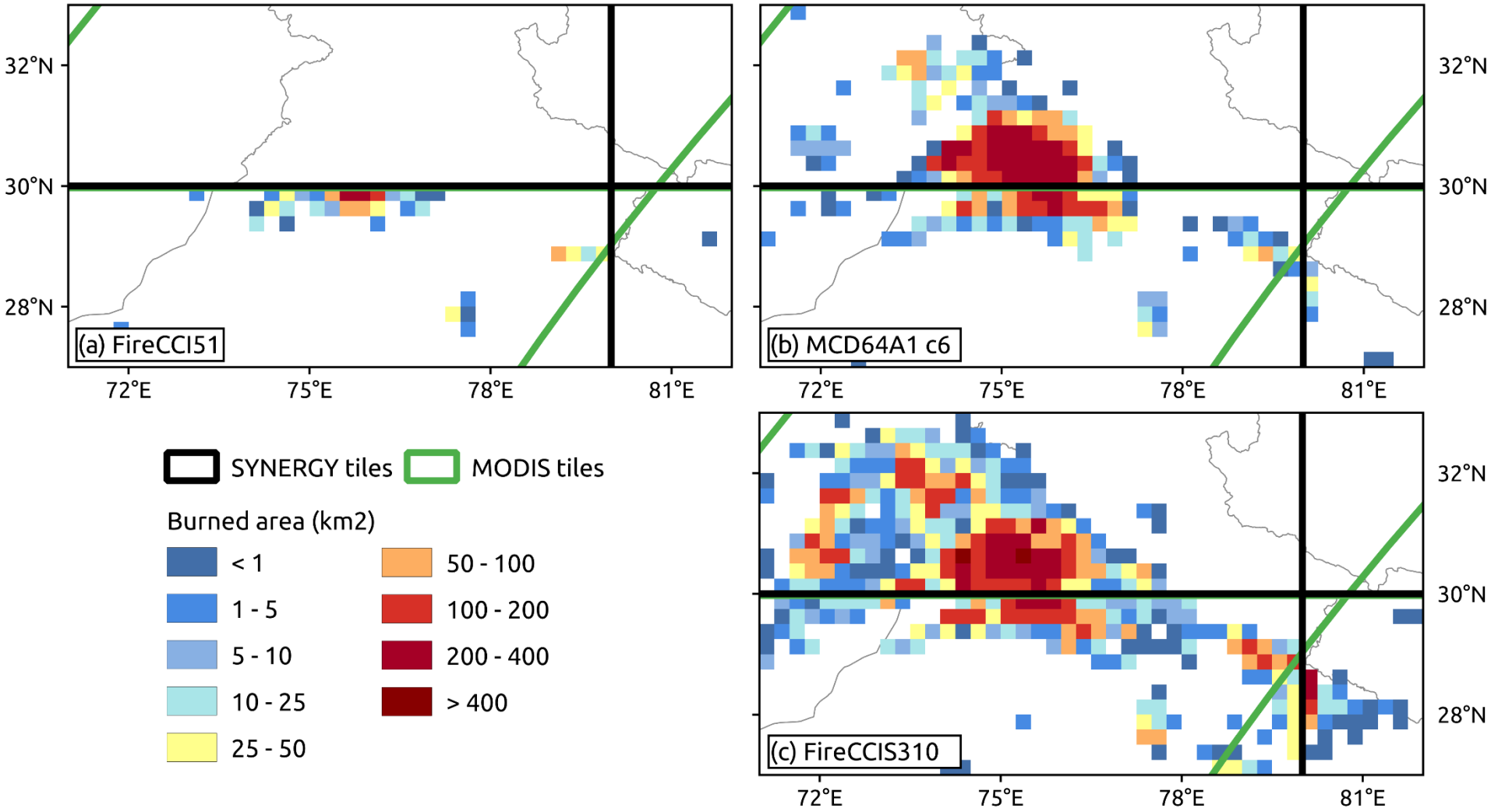
Results: global temporal validation



	FireCCI51	MCD64A1 c6	FireCCIS310
0-1 days	18.0%	**56.5%**	53.0%
0-3 days	46.0%	**78.8%**	76.7%
0-5 days	66.9%	**87.2%**	85.3%
0-10 days	92.6%	**96.2%**	95.4%

Lizundia-Loiola et al., in review

Results: border effect

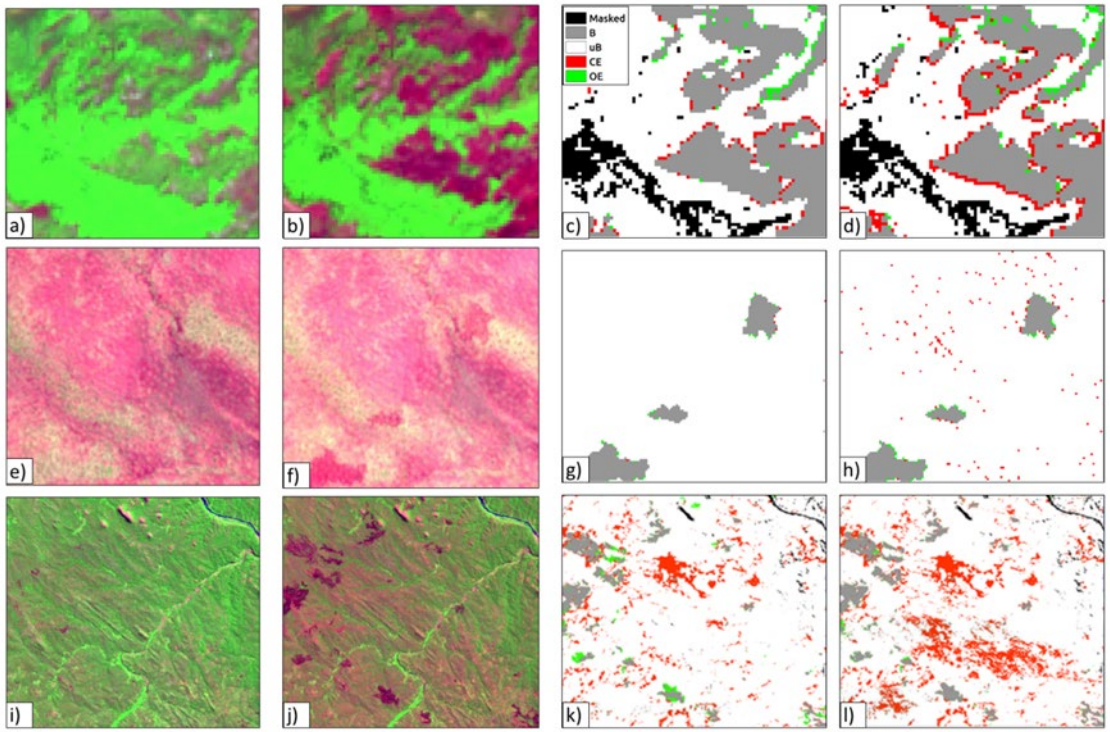


Lizundia-Loiola et al., in review

Regional products: Africa (2016 and 2019)

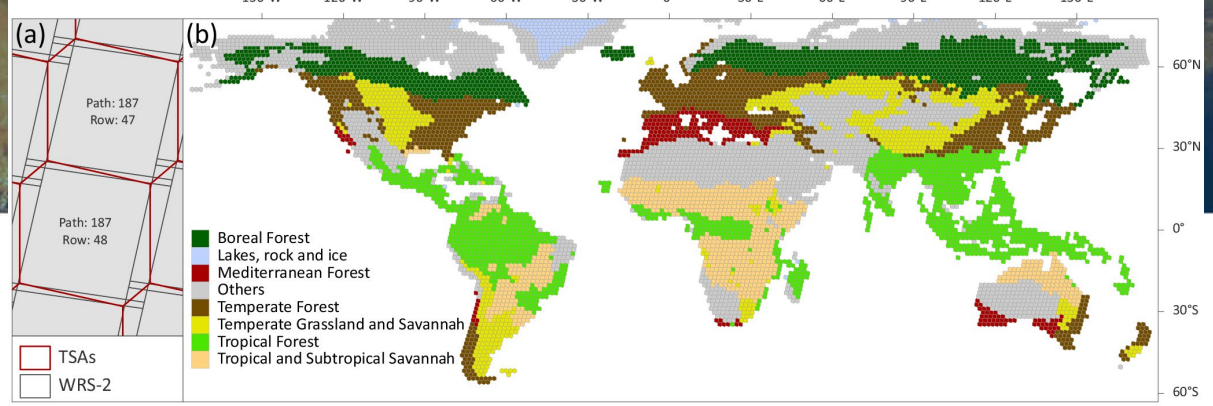
- 2016: Sentinel 2A
- 2019: Sentinel 2A and B. 150 Tb. Processed by Brockman using Calvalus in Creos-DIAS facilities.
  - Two satellites were observed to have a minor misregistration.
  - Two processors were run independently

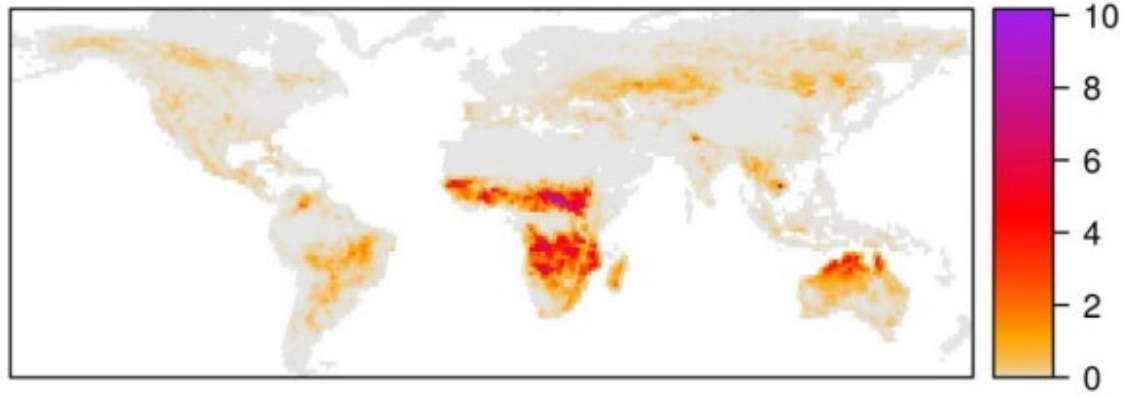
  and afterwards merged.



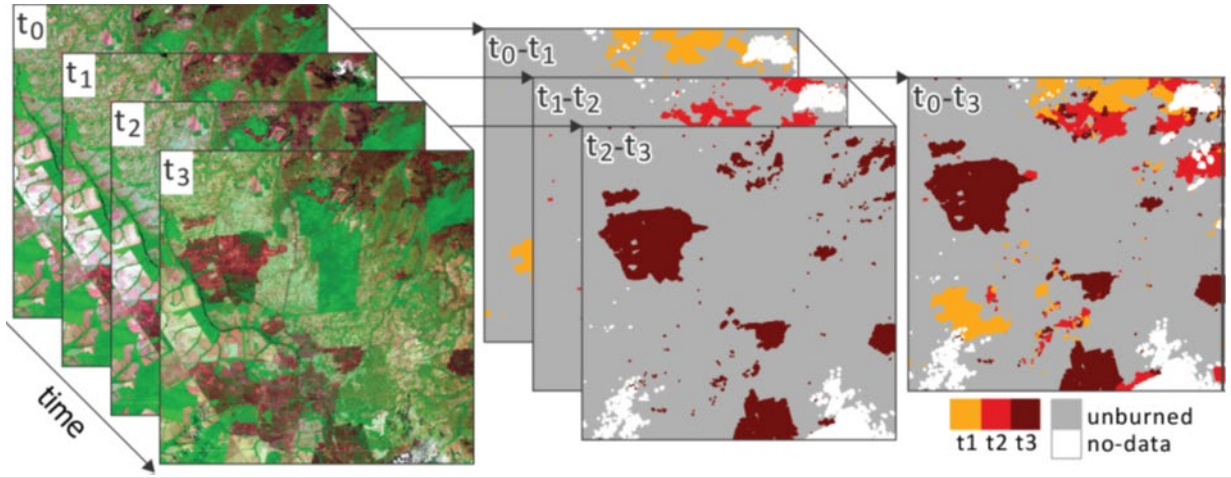
Validation

- Random stratified sampling of TSA
- Long-term sampling scenes:
  - Global: Franquesa et al., 2022 RSE.
  - Africa: Stroppiana et al., in review.

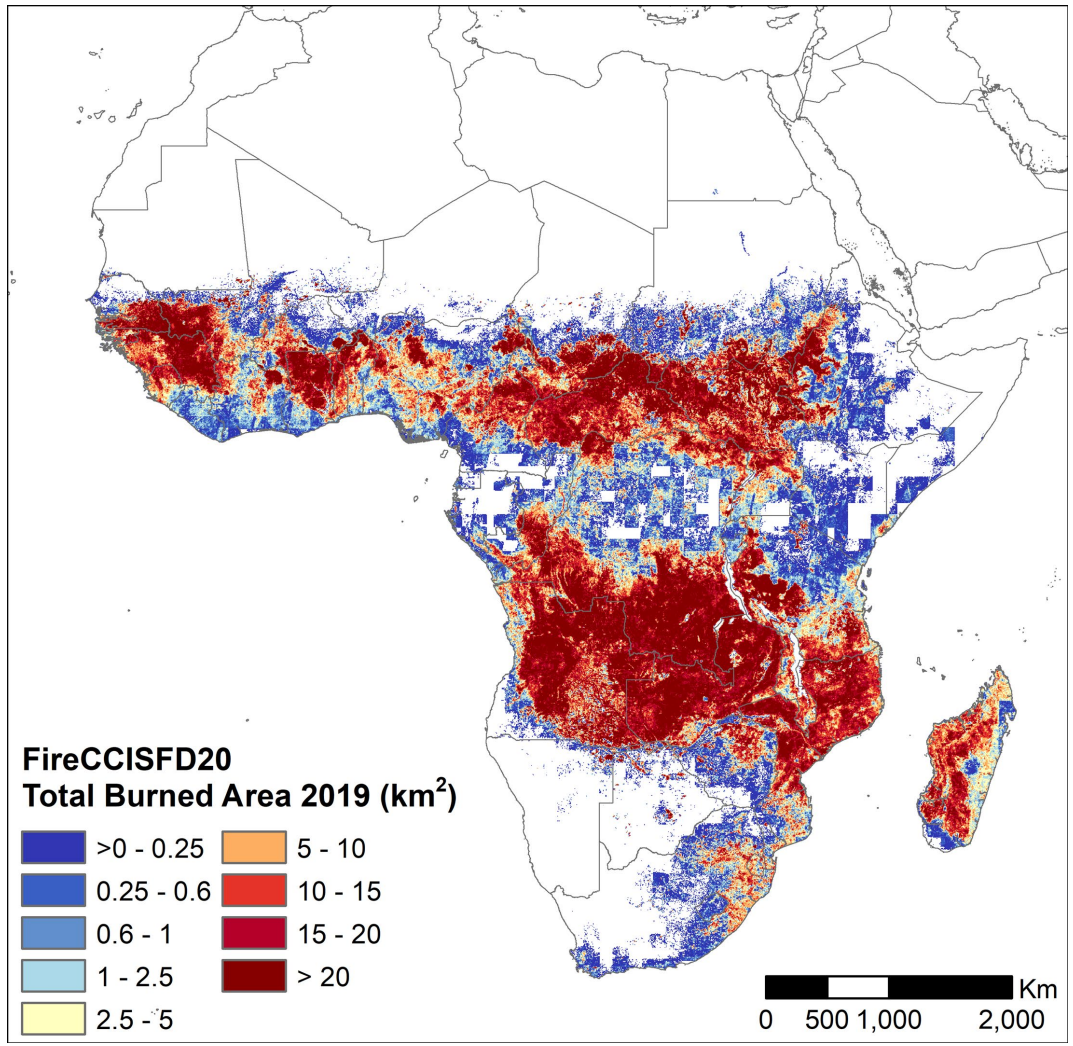




Producto	OE [%]	CE [%]	DC [%]	RelB [%]
FireCCISFD20	8.5	15.0	87.7	8.4
MCD64C6	56.5	21.1	56.0	-44,9
FireCCI51	52.2	25.1	58.4	-36.2

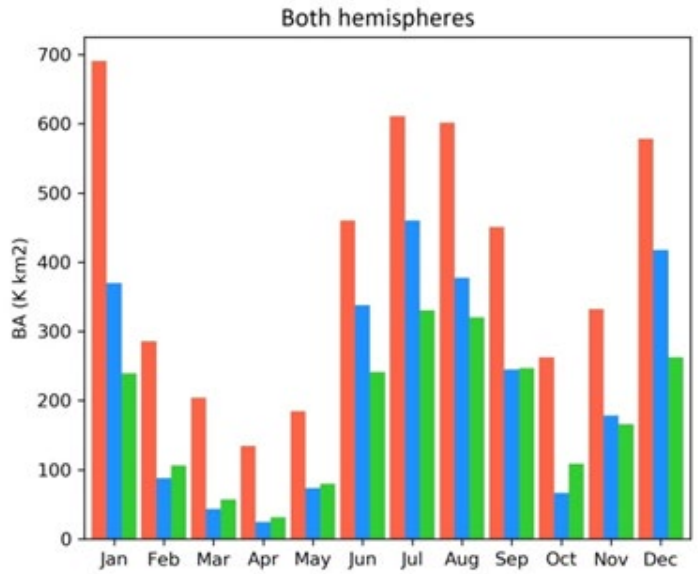


Regional products: Africa (2019) Sentinel 2A & 2B



(Chuvieco et al., 2022, STOTEN, in review)

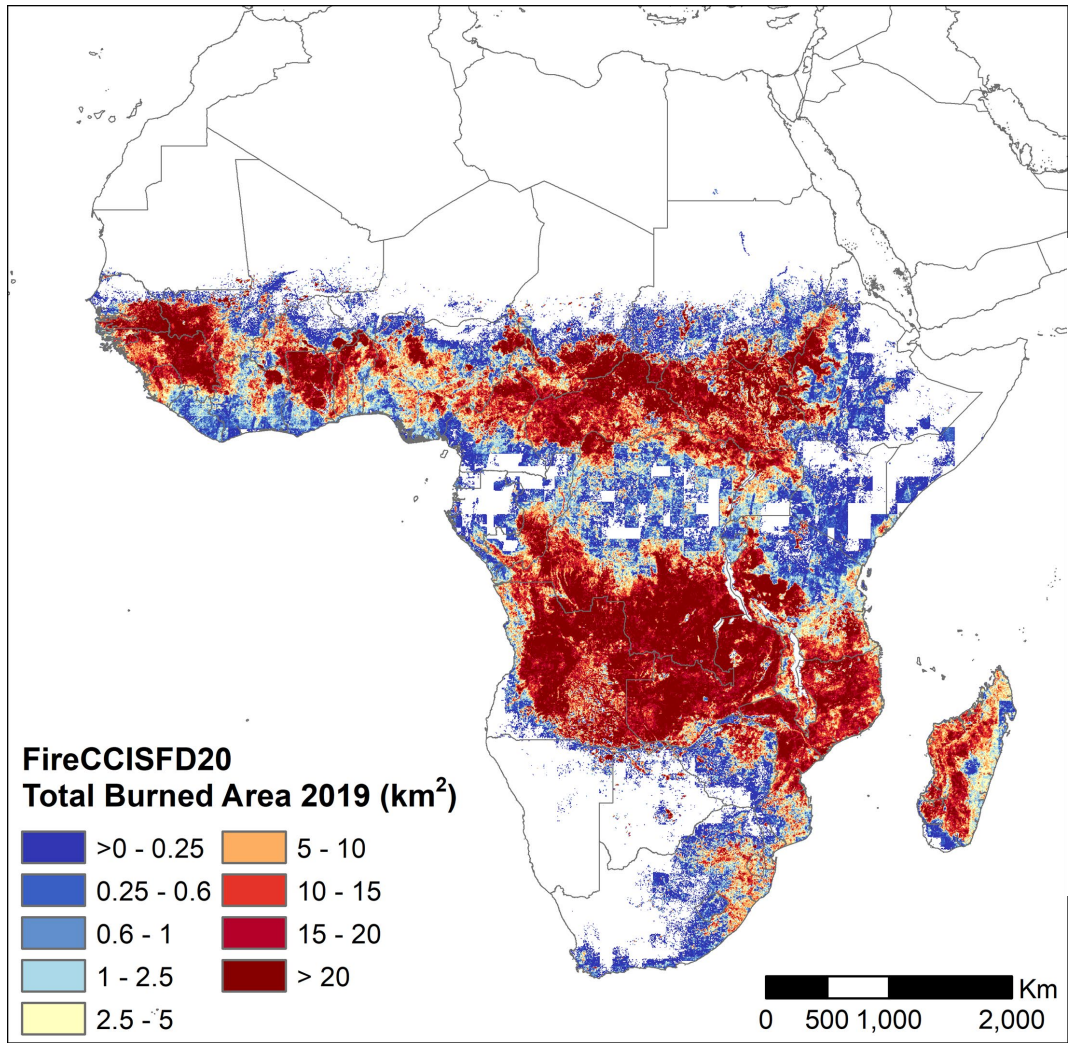
4.8 Mkm^2 just for Africa. More BA in all months



Lower omission errors than using one satellite: 8.5 versus 26.5 %
Similar commission error: 15 versus 19 %

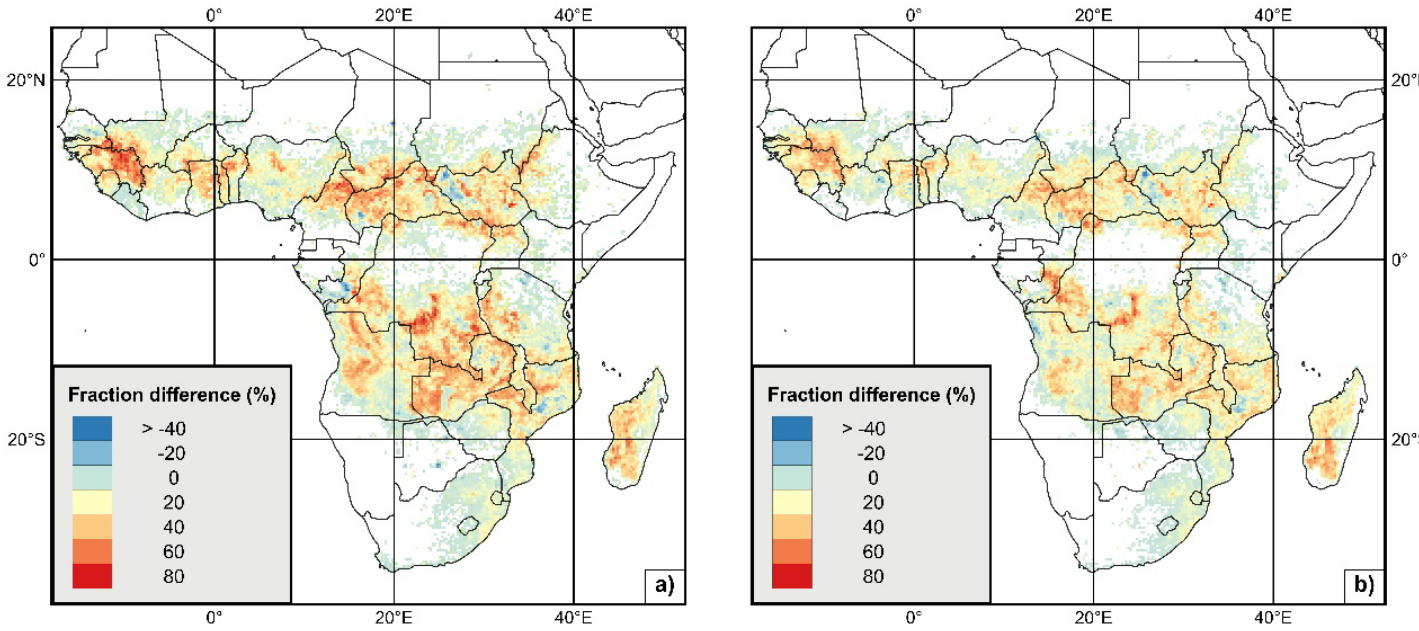
Both significantly lower than global products

Regional products: Africa (2019) Sentinel 2A & 2B



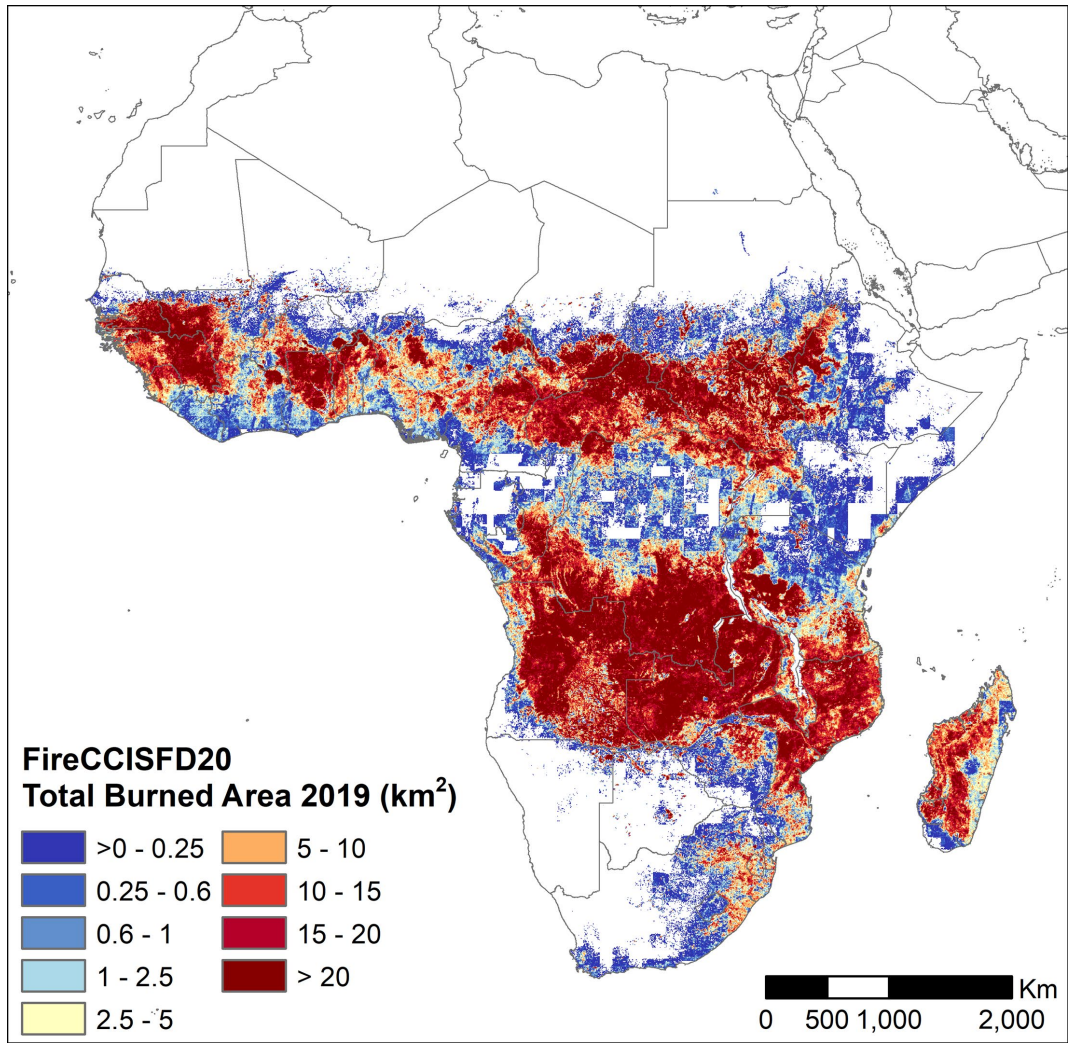
(Chuvieco et al., 2022, STOTEN, in review)

80% more BA than FireCCI51 (MODIS 250 m)
120% more BA than MCD64A1 (MODIS 500 m)



Difference in BA proportion between FireCCISFD20 and a) MCD64A1 and b) FireCCI51

Regional products: Africa (2019) Sentinel 2A & 2B



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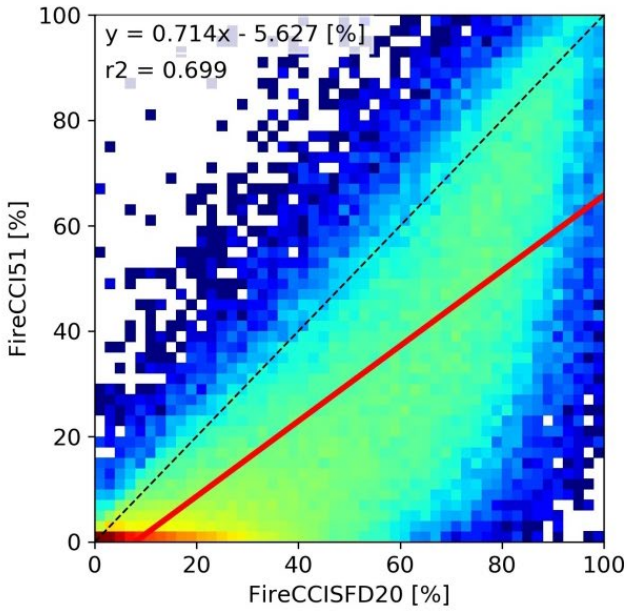
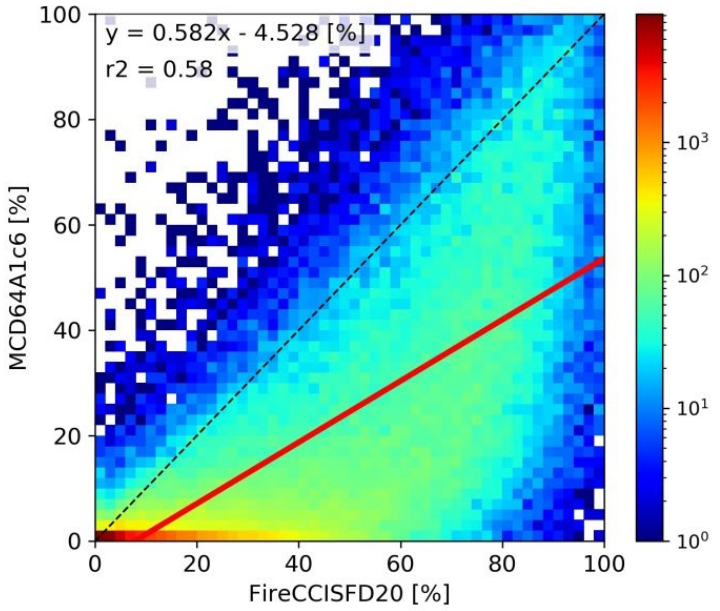
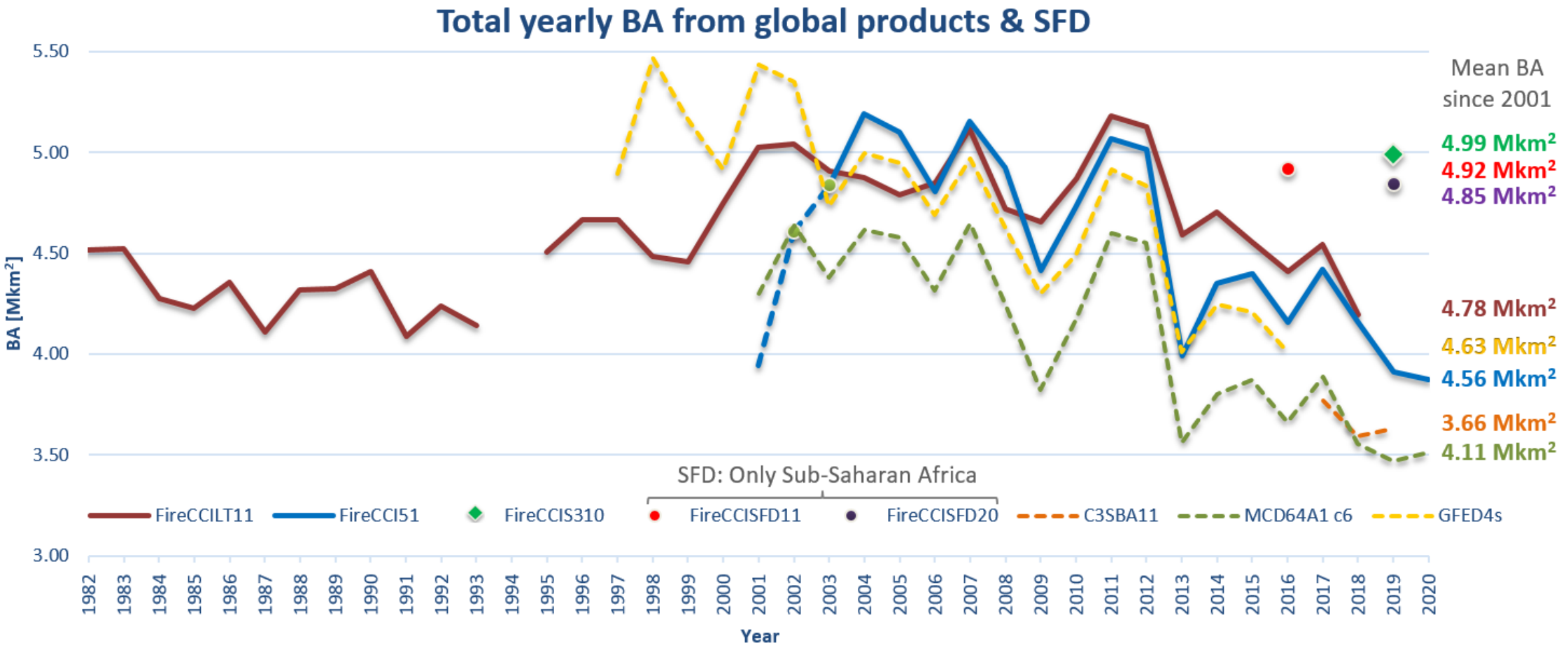




Fire trends in FireCCI products



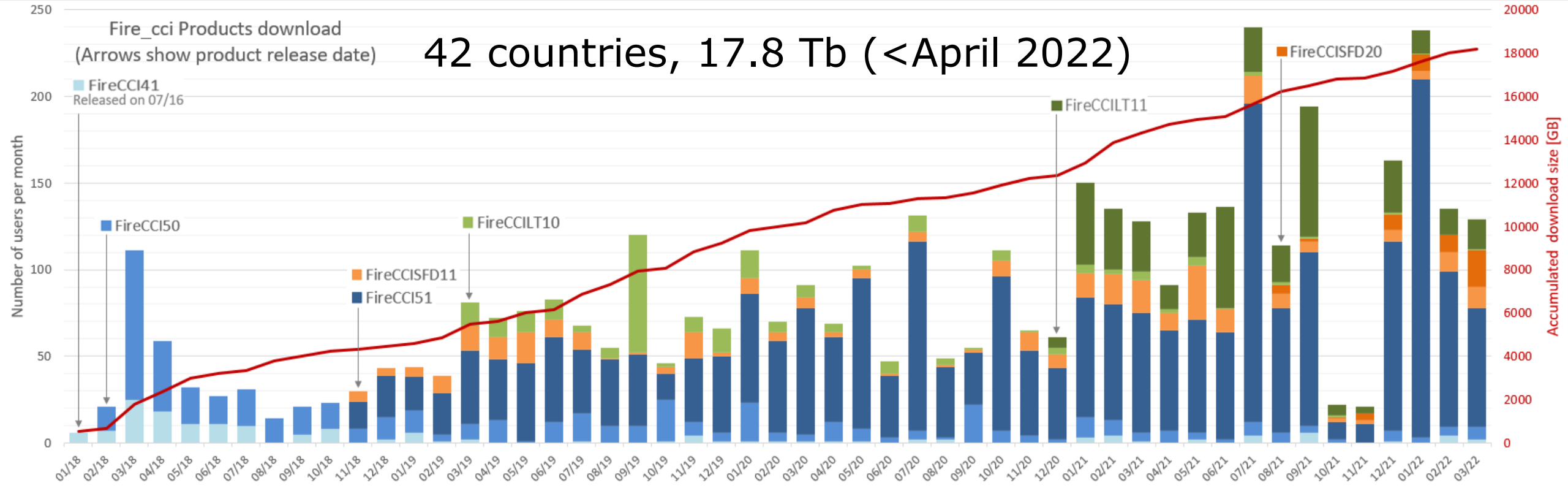
Downloadings of Fire CCI products

Global:

- FireCCI41: 2005-2011, MERIS: 300 m.
- FireCCI51: 2001-2019, MODIS: 250 m.
- C3SBA10: 2017-2020, OLCI: 300 m
- FireCCIS310: 2019, SYN: 300 m
- FireCCILT11: 1982-2018: AVHRR: 5 km.

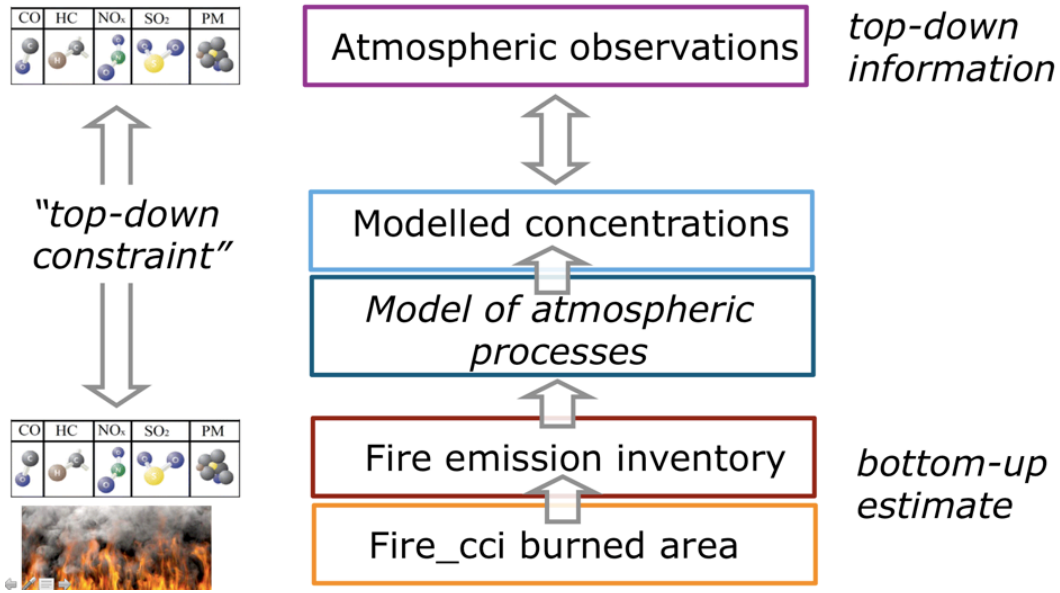
Regional:

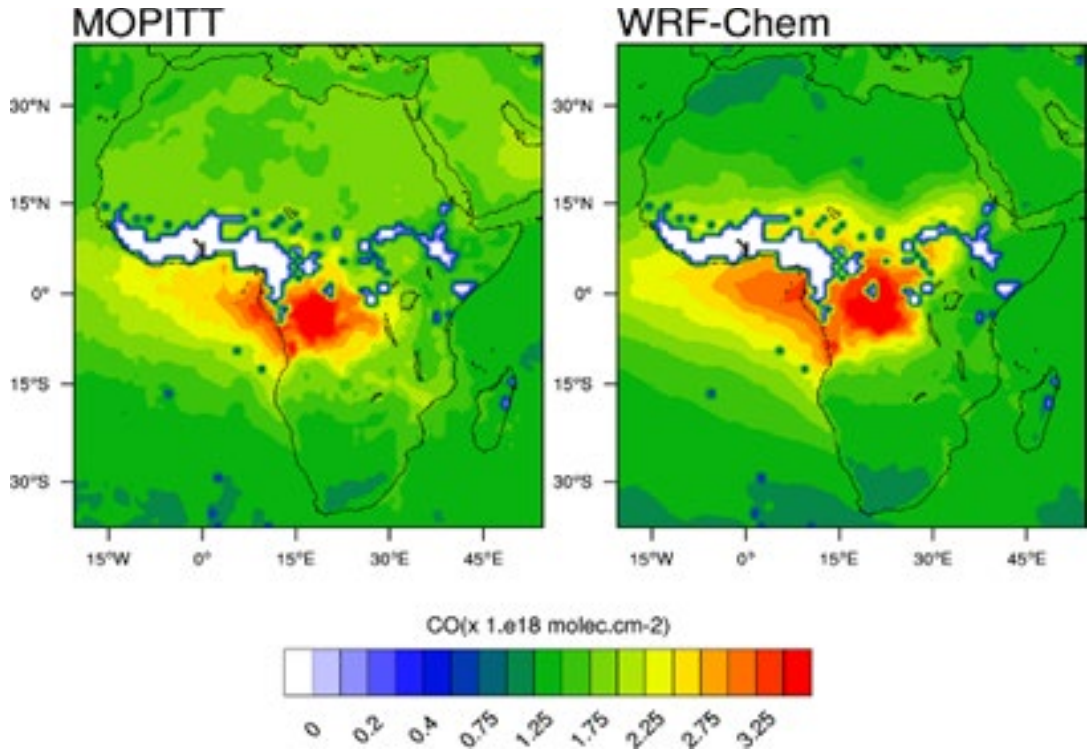
- Africa: FireCCISFD11: 2016 & 2019, Sentinel-2 20m
- Africa, Indonesia, Amazonia: FireCCIS1: 2016, Sentinel-1 40m.

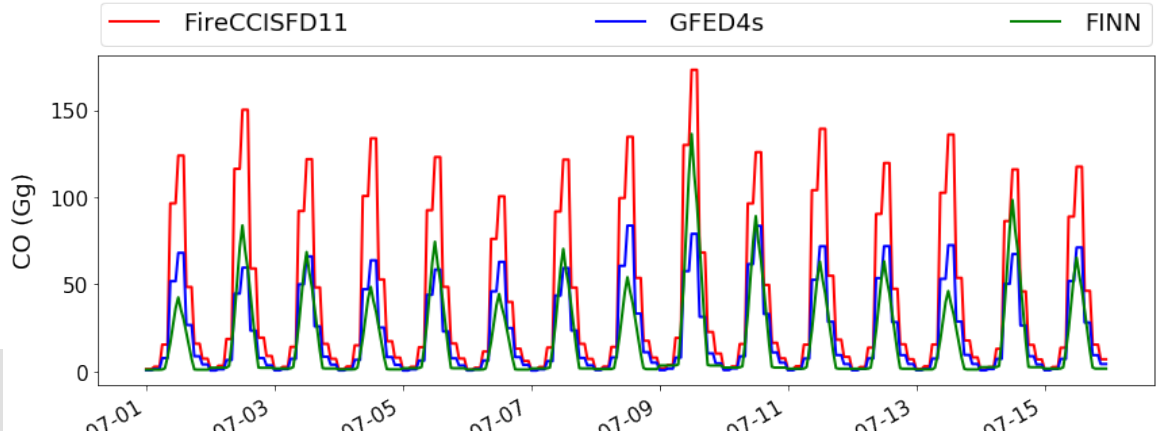


Science with BA data: fire emissions

- WRF-Chem Forecasting System for FireCCI+ (DKRZ, Hamburg, Germany)

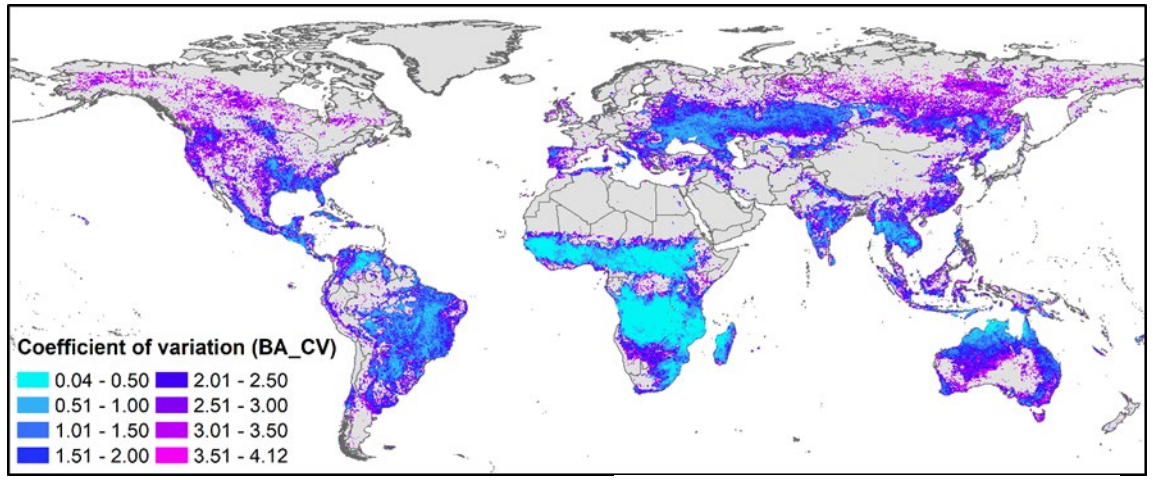


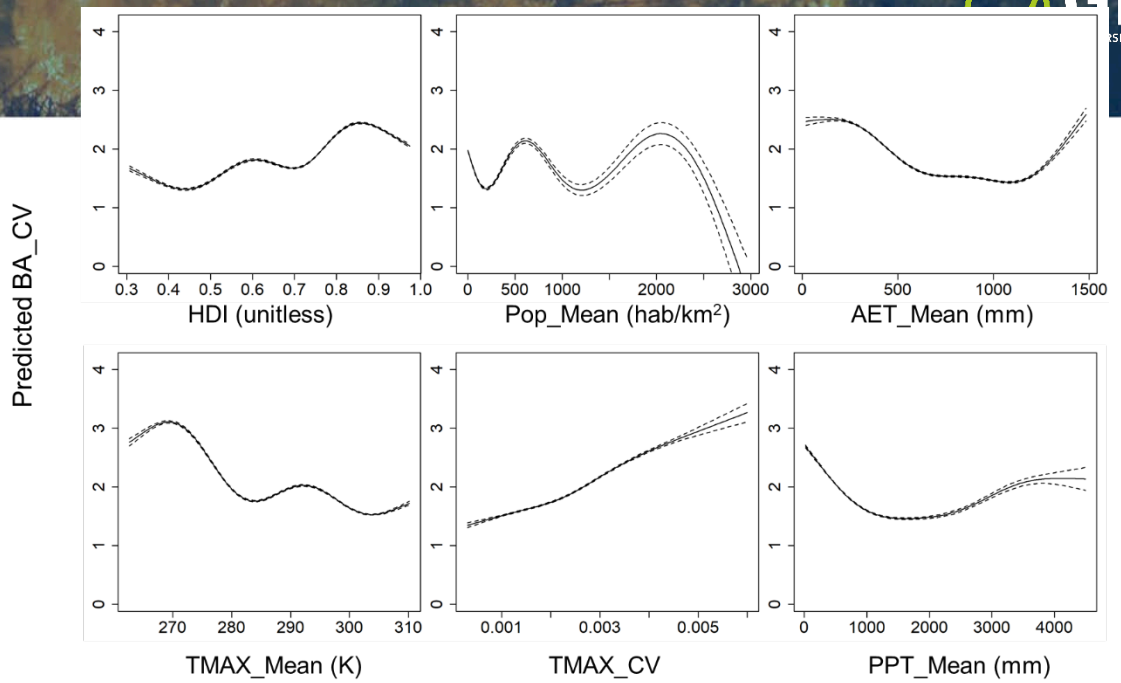


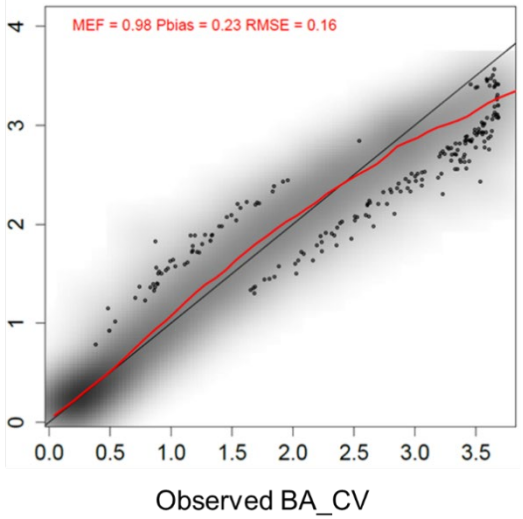


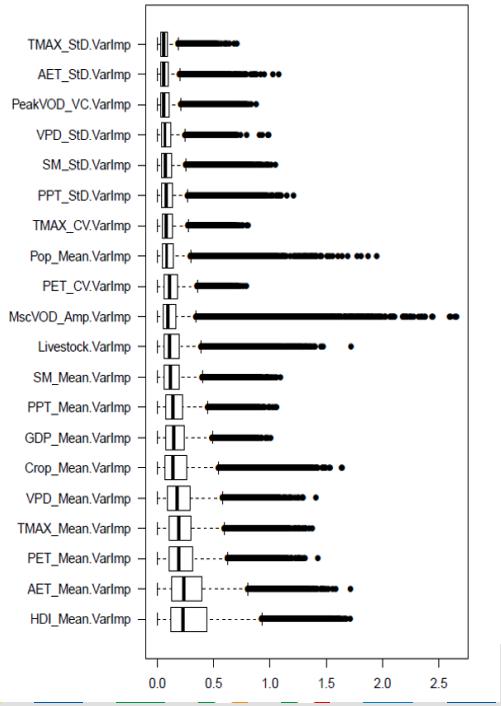
Heil et al., 2020, CAR

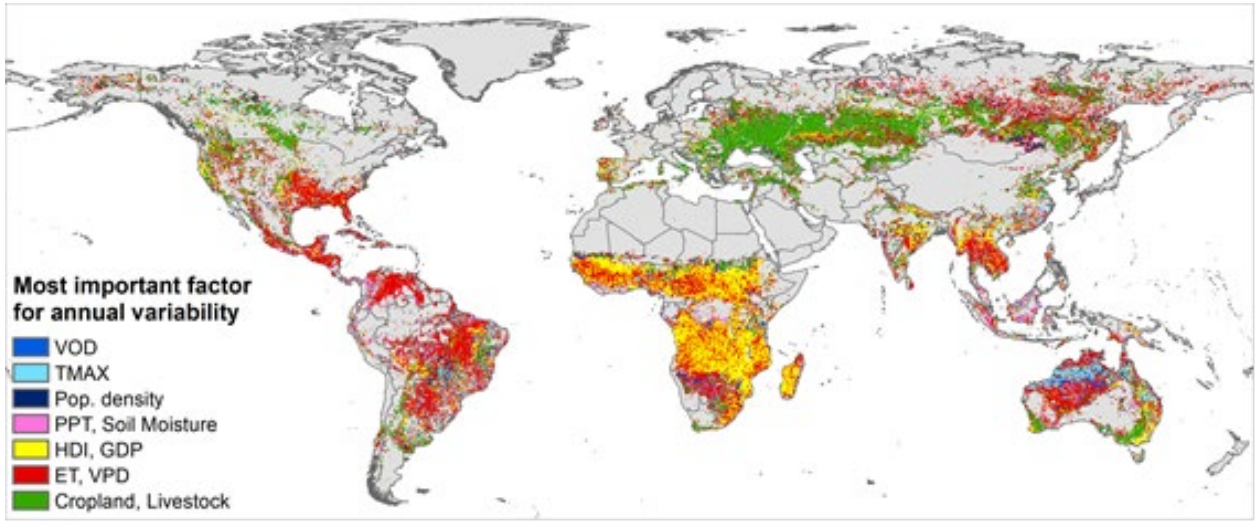
Drivers of fire variability





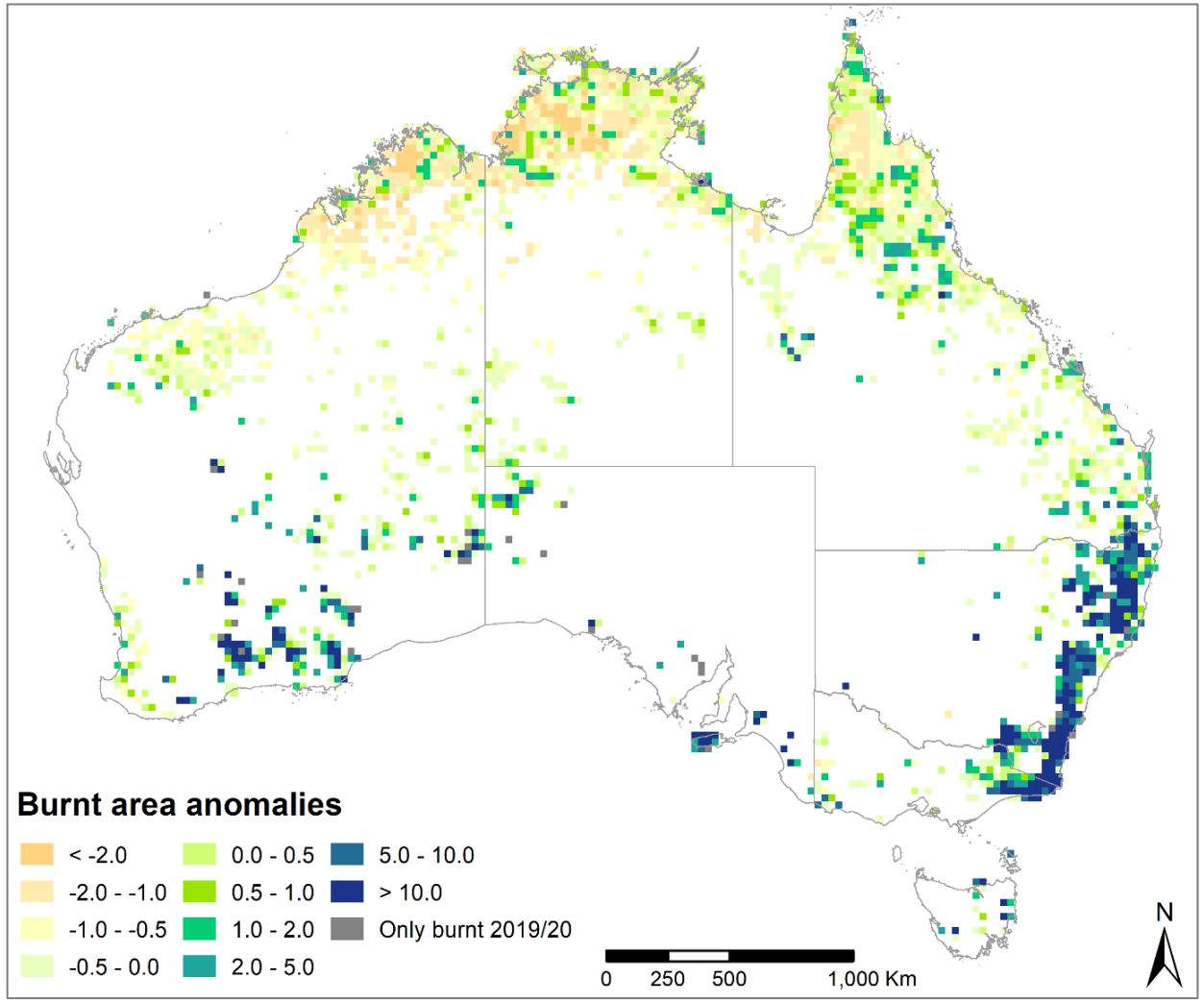






Chuvieco et al., 2021, STOTEN

Temporal anomalies



Bowman et al., 2020, Nature

Fire-and-rescue crew attend a blaze in Sydney, Australia, in 2019.

Wildfires: Australia needs a national monitoring agency

David Bowman, Grant Williamson, Marta Yebra, Joshua Lizundia-Loiola, Maria Lucrecia Pettinari, Sami Shah, Ross Bradstock & Emilio Chuvieco

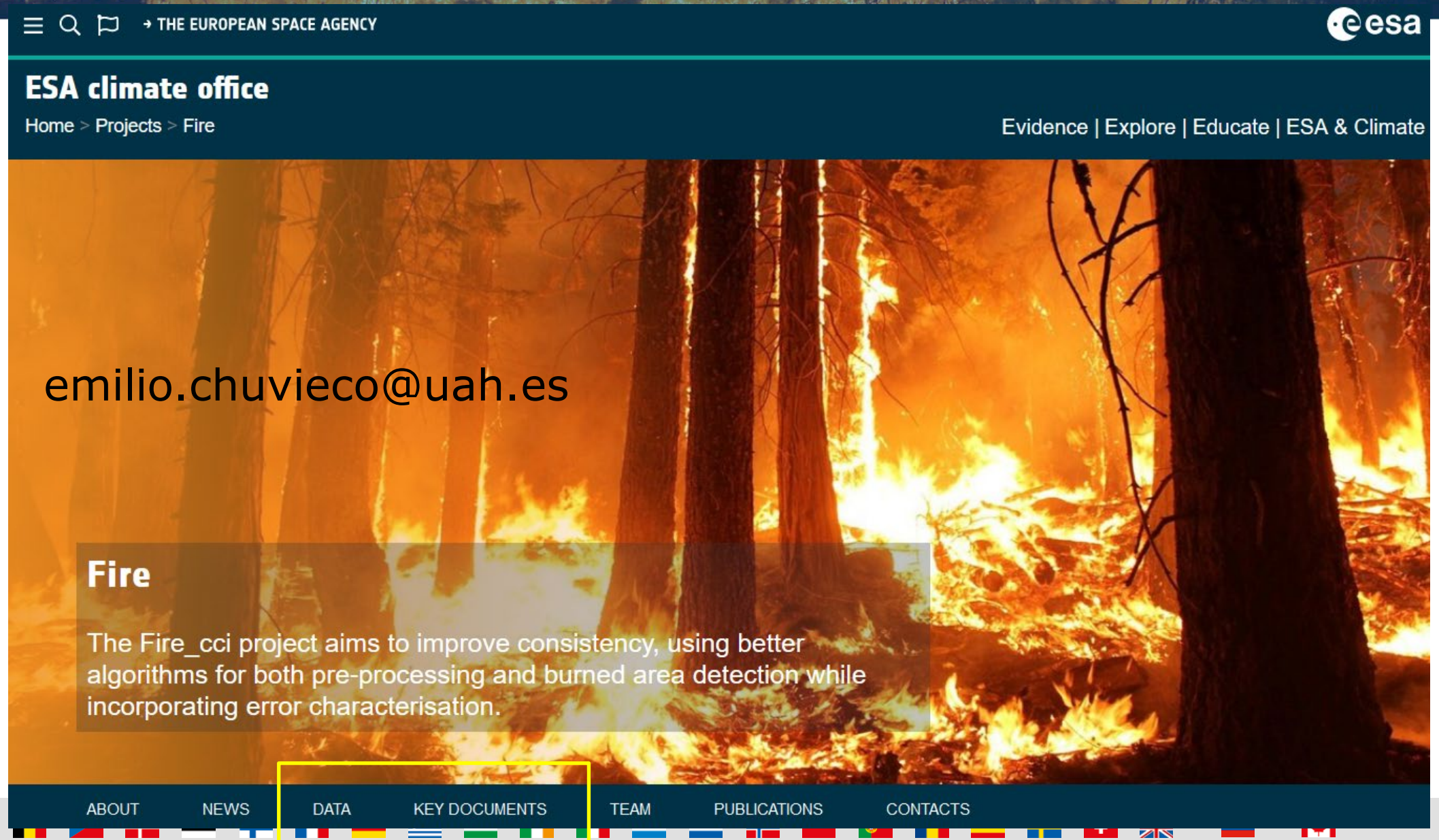
Comprehensive fire surveillance will strengthen resilience and adaptation to climate change.

Just before the COVID-19 pandemic, bush fires in Australia destroyed more than 3,000 homes and burnt millions of hectares of vegetation. The crisis exposed the nation's fire monitoring system as being unfit for purpose. Precise real-time information about the area burnt and the intensity of the fires was not available when it was needed.

Australia does not have a central system for gathering and storing essential information about bush fires. State and territory governments, and even agencies within states, have different approaches. This worked fine when fires were smaller. But those in the 2019–20 season crossed multiple state borders.

The blazes engulfed a huge geographic range and burnt for a duration and intensity that was beyond the experience of communities and fire managers[1]. Many Australians endured five months of smoke pollution that breached national air-quality standards. Usually, people would experience shorter bouts covering smaller areas[2].

https://climate.esa.int/en/projects/fire/



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